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ABSTRACT

This paper reports on two studies that were designed to provide preliminary data on the psychometric properties of a new matrix test of referential communication and to explore the validity of the test as a predictor of both developmental level and socioemotional adjustment of normal and emotionally disturbed children. Referential communication is defined as the process of verbal interaction in which one person imparts to another person information which the second person needs in order to carry out some task. Studies by Piaget and others are cited which indicate that children tend to be less egocentric in this communication as they grow older--that is, they increasingly take into account what the other person needs to know. The two present studies are then described. Study 1, carried out with 120 normal elementary school children, was concerned with establishing the developmental parameters of referential communication performance and with assessing the reliability of the instrument. In Study 2, the socioemotional correlates of referential communication were assessed in 125 moderately emotionally disturbed children. The instrument, a nonsubjective one, was found to be highly reliable. There was a strong age effect, with major shifts in test performance occurring at entry into both the concrete period and the formal operations period. Egocentric communication was found to be greater in emotionally disturbed children than in normal children. (Author/MS)

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A Matrix Test of Referential Communication

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A Matric Test of Referential Communication

Abstract

This paper reports on the development and validation of a new procedure for assessing referential communication performance in children and adolescents. There were two separate studies. In study 1, the developmental course of referential communication was charted in 120 normal elementary school children. In study 2, the socio-emotional correlates of referential communication were assessed in 125 moderately emotionally disturbed children. The instrument was found to be highly reliable. There was a strong age effect, with major shifts occurring both at entry into concrete operations as well as entry into formal operations. Performance on the task was found to be predictive of adjustment, as measured by a variety of teacher rating and sociometric instruments.

A Matrix Test of Referential Communication[1]

Stephen Greenspan[2] and Carl Barenboim

The term "referential communication" refers to the process of verbal interaction in which one person imparts to another person information which that second person needs in order to carry out some task. It is a commonly observed phenomenon that some persons are more "egocentric" than others in their referential communication performance, that is that they provide far fewer bits of information than are needed by the listener. Piaget (1926) was among the first to point out that young children are almost universally egocentric in their referential communication performance. Using simple assessment tasks such as requiring a child to relate the parable of the "Fox and the Grapes," he demonstrated that young children show little appreciation of the fact that effective verbal communication requires some systematic effort to overcome the informational deficiencies of the listener. The young child acts, in his referential communication behavior, as if all that is needed to communicate needs or descriptions is to throw out a few key words that are meaningful to him. He does not understand that what is in his head is not automatically available to other people. It is not until middle childhood, as Piaget showed in these studies of verbal understanding as well as in his studies of spatial perspective-taking (Piaget & Inhelder, 1956) that the child begins to develop the ability to simul-

taneously keep in mind the fact that what (s)he knows about an object or an event and what another person knows about that object or event are not necessarily the same thing. It is only when (s)he develops the ability to "decenter" between his or her perspective and that of another person that (s)he can effectively provide information needed to fill in the gaps in the other person's understanding (Piaget & Inhelder , 1969).

Recently, a number of investigators have shown a renewed interest in the concept of referential communication, especially as it relates to children. This interest has been expressed through two often overlapping lines of research, one involving an attempt to shed more light on the developmental parameters of referential communication performance, the second involving an attempt to examine the issue of individual differences in the development of communication competency and the role of socioemotional factors in that development. Several investigators have confirmed Piaget's early finding that effectiveness in referential communication performance increases markedly with age (Flavell, 1967; Flavell, Botkin, Fry, Wright & Jarvis, 1968; Rubin, 1973; Krauss & Glucksberg, 1969; Cohen & Klein, 1968). Although a variety of measurement strategies have been used by these and other investigators, the procedure which has achieved perhaps the widest acceptance has been that first described by Krauss and Weinheimer (1964), later modified in Glucksberg, Krauss and Weisberg (1966), and since used in any number of studies. This procedure involves use of a series of cardboard blocks with abstract nonsense

designs on them. These blocks have holes running through them vertically which makes it possible to stack them sequentially on a peg. The subject is given the task of stacking his or her cubes on his peg and then communicating the order in which (s)he placed the cubes on the peg to a listener on the other side of a screen.

The second line of research into referential communication has involved the investigation of socioemotional correlates of referential communication performance. These investigations have taken two forms: (1) the investigation of correlates between egocentric communication and various forms of psychopathology; (2) the attempt to accelerate the achievement of referential communication competency of children by developing training procedures designed to make them aware of the need to improve their communication skills. There have been, as far as the authors know, virtually no studies which have looked directly at the relationship between referential communication performance in children and emotional disturbance. This is surprising in light of the great deal of attention paid to the relationship between other social-cognitive variables such as "social role taking" and child psychopathology (Chandler, 1971, 1972, 1973a, 1973b; Martin, 1968; Neale, 1966; Thompson, 1968; Filer, 1972; Anthony, 1959). The majority of studies which have looked at the relationship between referential communication and psychopathology have been conducted with adults (Cohen, Nachmani & Rosenberg, 1974; Cohen & Cahmi, 1967; Smith, 1970). One

possible reason for this relative absence of research into the referential communication correlates of emotional disturbance in children is the absence of a widely accepted assessment instrument which is suitable for use with children of different ages and varying levels of verbal fluency and which possesses psychometric properties suitable for use as a personality assessment instrument.

There has been a great deal more interest shown in the problem of training children to overcome apparent referential communication deficiencies than in attempting to establish how those deficiencies affect or are affected by the child's competence in other areas. Studies by Fry (1966), Botkin (1966), Shantz and Wilson (1972), Flavell, Botkin, Fry, Wright, and Jarvis (1965) have attempted to devise training approaches, sometimes very ingenious ones, to accelerate the referential communication performance of elementary school children. These training studies involved, for the most part, quite normal children whose communication "deficiencies" (where these existed at all) were well within normal developmental limits and were not indicative of serious emotional or intellectual deficiencies. The authors, in collaboration with Michael Chandler, attempted in a previously reported training study (Greenspan & Chandler, 1973; Chandler, Greenspan & Barenboim, 1974; Greenspan, Burka, Zlotlow, & Barenboim, 1975) to develop a training approach, using two-person communication games, which was aimed specifically at children who were emotionally disturbed and who were highly egocentric in their communication and role-taking behaviors.

It was in the process of developing the training investigation mentioned above that the authors became convinced of the need to develop a new instrument for assessing referential communication performance in children. The most widely used assessment procedure, that of Krauss and his colleagues (Krauss & Weinheimer, 1966; Glucksberg, Krauss, & Weisberg, 1966; Krauss & Glucksberg, 1969) has two principal drawbacks for use as an assessment instrument. The first drawback has to do with the scaling dimensions of the task. There are six cubes, each with a different abstract nonsense design. The subject is asked to describe the cube (s)he is selecting and the order of his or her placement. Since order is implicit in the sequence of a child's comments, there is really only one dimension of the task which can be said to differentiate subjects and that is his or her effectiveness in communicating the shape of the design. Because the designs are quite abstract in shape, one is forced either to use highly subjective scoring procedures for assessing the child's communication performance or else one is forced to rely on length of utterance which, while it may illustrate an awareness of the difficulty of the task, may or may not be related to adequacy of communication. The second drawback is that far too much emphasis is placed upon the child's ability to verbally label the objects. Longhurst and Turnure (1971) and Grushcow and Gauthier (1971) pointed out this problem and suggested that the task used by Krauss and associates confounded referential communication performance with verbal encoding

ability. Thus, when Krauss (1971) concluded that referential communication performance was a reflection of verbal encoding ability, he may have been basing this inference on results which were an artifact of a task which made heavy use of abstract symbolic designs for which young children may not have had readily available labels. An alternative explanation to Krauss', which stems from Piagetian theory, is that young children are poor communicators because they cannot coordinate the depictive (symbolic) with the instrumental (referential) aspects of the task. In order to test this hypothesis, however, it is necessary to use stimulus materials which are easily encodable.[3]

The assessment procedure described in this paper and used in the Chandler, Greenspan and Barenboim (1974) study was initially developed by the first author of the present paper, and was designed to overcome some of the drawbacks mentioned above. The task uses simple objects the dimensions of which (geometric shape, color and size) are well within the verbal encoding ability of virtually all young children. Furthermore, since the child selects nine objects from a much larger group of objects, and places these within a matrix, the child must, if (s)he is to communicate effectively, simultaneously attend to a whole variety of dimensional aspects of each object (five to be precise), including vertical and horizontal direction, and cannot simply focus on shape and ignore the other dimensions of difference among the objects. The increased scale values of this test increase the chances of maximizing the contribution made by true variance, and hence of

achieving validity, as pointed out by Kerlinger (1964). Finally, the matrix test is relatively simple to score and does not require the use of subjective ratings or corrected scores.

The present study was designed to provide preliminary data on the psychometric properties of the matrix test of referential communication and, in addition, to explore its validity as a predictor of both developmental level and socioemotional adjustment of normal and emotionally disturbed children. Developmentally, it was predicted that there would be a gradual quantitative increase in referential communication performance on the task across middle childhood. It was predicted that major improvements in performance on the task would roughly conform with age trends established with other purely cognitive Piagetian tasks such as conservation and classification. These major jumps in performance were predicted to occur shortly after the beginning of elementary school (when the child achieves "concrete operations") and around the onset of adolescence (when the child achieves "formal operations"). In addition to undertaking this developmental study (with normal children) a variety of studies were also undertaken, using emotionally disturbed children, which were designed to explore the utility of the matrix task in differentiating children according to their level of socio-emotional adjustment.

METHOD

Subjects and procedures: study 1 -- Varying numbers and types of subjects were used in different parts of the unfolding study design. The overall study may be viewed as containing two parts. Study 1 was concerned with establishing the developmental parameters of referential communication performance and with gathering data on the reliability of the assessment instrument. The study was carried out with 120 children attending regular classrooms in a largely white middle-class suburb outside Rochester, New York. To establish age trends, the "matrix test" of referential communication was administered to these 120 children (20 children at each of grades 1 through 6, equally divided between boys and girls). Although IQ data was not available, all of the subjects were considered to be of at least normal intelligence.

To establish test-retest reliability, one-half of the subjects were randomly selected for retesting on the same instrument, three weeks later, by different testers who did not have access to the initial test scores. Inter-rater reliability was established by having the two authors independently score the written protocols of 38 subjects. These protocols were randomly selected from among the retest protocols of the 60 children who had been selected for retesting. The raters had not done any of the retesting and were unaware of the grade and sex of the subjects.

Subjects and procedures: study 2 -- Study 2, which was concerned with examining the relationship between referential communication

and the socioemotional adjustment of children, was carried out in two community-supported institutions for moderately emotionally disturbed children. The institutions were both located in Rochester, New York. A greater part of the total census of the two institutions, 125 children (95 boys and 30 girls) between the ages of 8 and 15, were initially screened on the referential communication test. This occurred during the first two weeks of the Summer recess period. From this population, smaller numbers were used in the various procedures described below. The populations of the two institutions were almost identical. The children came mostly from white working class and lower middle class backgrounds. While these subjects had been referred for residential treatment from a variety of sources and were characterized by a variety of admitting diagnoses, frankly psychotic and seriously retarded children were routinely excluded from admission to these facilities. The large majority of these children were described as antisocial and had evidenced chronic adjustment problems at home and at school, which were viewed by the professional staff as largely situational in nature. Although recent IQ data was not available, most of the children were considered to be of normal intelligence.

The two institutions, which will be referred to as "Institution A" and "Institution B", are comparable in terms of size, type of population, physical facilities, staff qualifications,

operating philosophies, and sources of community funding. The typical length of stay at the two places, which varied as a result of the child's prognosis and the degree of family disorganization, was between a year and three years. One salient difference between the two institutions is the fact that institution B is operated by a Catholic woman's religious community and contains a mix of lay and religious staff, while institution A is an entirely lay organization.

Five measures of the relationship between referential communication performance and socioemotional adjustment in these institutionalized children were obtained. Three of these measures were cross-sectional in nature, while two were longitudinal. The first of the cross-sectional measures involved a comparison of the referential communication performance of thirty 11- and 12-year old subjects (21 boys and 9 girls) from the institutionalized sample, who were matched for age and sex with an equal number of subjects from the normal sample described in study 1. Since possible group differences in socioeconomic level and intellectual ability were not controlled for, this kind of comparison is of limited usefulness as a test of the validity of referential communication in differentiating normal from emotionally disturbed children, as results of studies by Baldwin, McFarlane, and Garvey (1971) and Krauss and Rotter (1968) would suggest. Nevertheless, a positive finding would be an encouraging indication that referential communication may indeed possess this predictive validity, while a negative finding would be a rather clear indication that it did not.

As a second cross-sectional index of the validity of referential communication in differentiating children according to their level of socioeconomic adjustment, children at the two institutions were rated by their peers on a sociometric instrument. A total of 40 children (20 at each place) were selected for rating by their peers. The ratees were selected on the basis of their being either "egocentric" or "nonegocentric," i.e., that they scored either above or below the mean referential communication score for the two institutions. The mean referential communication score for the egocentric group was 33.0 (compared to an overall combined institutional mean of 19.7) while the mean referential communication score for the non-egocentric group was 6.9. Each of the 20 ratees at each institution was rated by 10 of their peers at that institution. An effort was made to ensure that the group of raters likewise contained an equal number of egocentric and non-egocentric children. In addition, it was determined that all of the raters had been at their respective institution long enough to know all of the children being rated.

The sociometric instrument which was used was the "class play" devised by Bower (1969). As this instrument is typically used, respondents are asked to nominate, from among their classmates, persons to play each of twenty parts in a proposed class play. The parts have titles which have relatively obvious positive or negative overtones. As used in the present study, raters were asked whether each of the ratees would be suitable or not suitable for each of 19 parts (one part was dropped from

the study because of ambiguous wording). The procedure was individually administered to each of the raters by an interviewer who explained that he was interested in children's drama and would like the subject to imagine that he were the director of a class play and were faced with the task of casting actors in various parts. Then a particular ratee was mentioned and the interviewer went through a list of 19 parts, asking whether the ratee would be suitable or not suitable for each of those parts. Once a ratee was rated on all 19 parts, the interviewer went on to the next ratee and repeated this procedure. All 20 ratees at each institution were thus rated on all 19 parts by all ten of the raters.

Of the 19 parts on which all 40 subjects were rated, 10 had positive connotations and 9 had negative connotations. Only actual nominations (i.e., that a ratee was suitable for a part) were used in computing sociometric scores; since a statement that a ratee was "not suitable" could mean many things, no score was given for a failure to nominate for a given part. A nomination for a part with socially desirable overtones was given a plus 1, while a nomination for a part with socially undesirable overtones was given a score of minus 1. The ratings of the 10 raters at each institution were summed in order to derive a summary sociometric score for each ratee. Since there were 10 positive and 9 negative items for each class play, summary sociometric scores could range from a high of plus 100 to a low of minus 90 for each ratee. To test the validity of the referential communication test in predicting sociometric status, separate

point-biserial correlations were carried out at each institution between ratees' egocentrism status and summary sociometric score as derived on the modified class play procedure.

As another index of socioemotional adjustment, professional staff at each institution were asked to fill out a rating instrument on the same 40 egocentric and non-egocentric children who were used in the peer rating procedure described above. In order to minimize methods variance, the same modified version of the "class play" was used in the staff rating procedure as was used in the peer rating procedure. One highly qualified staff person at each institution was asked to say whether each of the 20 ratees at that institution was suitable or not suitable for each of the 19 parts. It was explained that the reason for using this obviously child-intended instrument was that it was also being used in a peer rating study and it was desirable to use the same measure if possible. Instead of being interviewed, the staff person was given a batch of 20 rating forms and was asked to check off those parts for which (s)he would nominate the ratees. The scoring of the items was identical to that described above with regard to the peer rating procedure except that, since there was only one staff rater at each institution, there was no need to sum scores across raters. Ratings for each ratee could range, therefore, from a possible high of plus 10 to a possible low of minus 9. To test the validity of the referential communication test in predicting staff rating of behavior, separate point-biserial correlations were computed at each institution

between ratees' egocentrism status and their score on the staff rating instrument.

As an additional way of indexing the validity of referential communication in predicting socioemotional variables, an attempt was made to examine the relationship between short-term change in referential communication and long-term improvement or regression in adjustment. The change score in referential communication was determined over a three-month period using pre- and post-measures. Change scores in socioemotional adjustment were determined at two points in time: at 6-months and again at 12-months after the post-test of referential communication was obtained. This investigation involved 48 subjects (32 boys and 16 girls) who were all initially selected on the basis of being relatively egocentric, that is, having referential communication scores higher than the mean score for both institutions. Twenty-five of the subjects were from Institution A, while twenty-three were from Institution B. The mean pre-test referential communication score of the 48 subjects was 29.7, compared to an overall mean for the two institutions of 19.6. Of the 48 subjects involved in this longitudinal investigation, 32 received weekly social perspective-taking training, over a 10-week period. One-half of these 32 subjects were in a role-taking group in which videotaped dramatic episodes were constructed. The other 16 were in a referential communication training program in which groups of two children played communication games. The nature of these different training approaches is described in Chandler (1973), Greenspan and Chandler (1973), Chandler, Greenspan and Barenboim (1974) and Greenspan, Burka, Zlotlow, and Barenboim (1975).

The other 16 children were in a non-treatment control group and received no training in perspective-taking whatsoever.

The referential communication change score was derived by re-assessing all of these 48 subjects on the matrix test of referential communication, using testers who were unaware of the subjects' initial test scores or experimental condition. This second testing occurred approximately three months after the initial assessment, on the same instrument, was completed. The testing and training was done over the Summer recess period. In order to assess changes in adjustment, professional staff persons at the two institutions were asked to rate the subjects on rating instruments, which directly measured the amount of improvement or regression which had occurred, in various behavior dimensions, over the preceding months. These instruments were administered at two points in time: 6-months and again at 12-months after the post-test score of referential communication had been obtained for all 48 subjects. The raters were unaware of the subjects' test scores, of their participation in a particular training condition, and of the experimenters' expectations. In order to test the hypothesis that improvement or regression in referential communication is predictive of later improvement or regression in social adjustment, separate correlations were computed at each institution, between referential communication change and rated behavioral change over both the 6-month and 12-month periods.

A somewhat different behavioral change rating instrument was used at the 6-month followup than was used at the 12-month

followup. The 6-month followup instrument was a modified version of the "AML" checklist developed by Cowen, Dorr, Clarfield, Kreling, McWilliams, Pokracki, Pratt, Terrel and Wilson (1973). The original AML instrument contained 11 items, designed to measure aggression, withdrawal, and learning disorder problems in elementary school children, by having teachers check off various items as they applied to their pupils. The instrument used in the present study contained an additional 12 items, designed to measure behaviors with seemingly special relevance to egocentrism such as communication effectiveness and sensitivity to disapproval. The other major procedural change, besides adding supplementary items to the AML checklist, was to ask staff persons to rate the subjects on change on these 23 items, over the preceding 6-month period, rather than on the degree to which the items applied to the subjects. A single rater at each institution was asked to rate the children involved in the longitudinal study at that institution, on the degree to which their behaviors had become more or less like the behaviors described by the 23 items, over the preceding 6-months. In making their rating, raters were asked to check off one of five columns for each of the 23 adjectives for each ratee: "has become much more," "has become somewhat more," "no change," "has become somewhat less," and "has become much less." In calculating change scores for each ratee, attention was paid not only to the magnitude of the rated change on the item but the adjustment connotations of the item as well. Thus if a subject had become "much more" on a socially positive adjective such as "cooperative," he would receive a plus 2 on that item, while a rating of "somewhat more" would receive a plus 1 and "no change"

would be zero, "somewhat less" would receive a minus 1, and "much less" would receive a minus 2. On the other hand, if the adjective had socially undesirable connotations (such as "bullies other children"), the sign of the rating would be reversed. Thus if a child became "much more" of a bully (s)he would receive a minus 2 while if (s)he became "much less" of a bully (s)he would receive a plus 2. Thus a positive summary change score would indicate improvement while a negative score would indicate regression. Summary scores were calculated by totalling all of the scores received on all 23 items by each ratee. Thus, behavior change scores at the 6-month followup assessment could range from a high of plus 46 (marked improvement) to a possible low of minus 46 (marked regression). As mentioned, the ratings were made by a single staff person at each institution. These persons had considerable experience and training in working with emotionally disturbed children, and because of their positions (recreation director) came in continual contact with most of the children. Since only one rater was used at each institution, there was no need to sum ratings across raters. Because the raters at the two institutions may have been utilizing the scale differently, the decision was made to compute two separate correlation coefficients, one for each institution, for the relationship between short-term change in referential communication and behavioral change, as assessed 6 months later, on the staff rating instrument.

The 12-month longitudinal followup of behavior change used, as mentioned, a somewhat different assessment instrument.

Since this investigation covered a considerable time span, it was felt that it would be unrealistic to expect raters to make differentiated judgments about behavioral change. Rather than use a multi-item inventory, therefore, it was decided to use a simple global rating procedure in which raters were asked to rank order subjects according to the degree of behavioral improvement or regression over the preceding 12-month period. Two raters at each institution (the same two raters used in the 6-month followup were supplemented by the addition of two other senior staffers) were independently asked to rank order all of the involved subjects at their institution according to the amount of positive or negative change observed over the preceding year. Because it was not expected that there would be very high inter-rater reliability on this ranking procedure, the decision was made not to combine the rankings but to compute four separate Spearman rank-order correlation coefficients, one for each rater, between referential communication change and behavioral change as assessed 12-months later.

The matrix test of referential communication: materials, administration, and scoring -- The matrix test of referential communication was developed by the first author for use in this and the earlier training study (Chandler, Greenspan & Barenboim, 1974). It was briefly described in Greenspan and Chandler, 1973 and in Chandler, Greenspan and Barenboim (1974). The test materials consist of two identical pieces of poster-board, 18 inches by 15 inches, each divided up (with marking pencil) into a 3 by 3 matrix. In order to assist children with the naming of lateral directions, the columns are each colored different colors. In addition to the boards, there are 18 geometric objects, half large (4 inches in height) and half small (2.5 inches in height). The objects come in three distinct colors (different from the three colors used for the columns) and three shapes (circles, squares and triangles). The 18 objects represent one example of all combinations among the three dimensions of difference. Thus there is one small red circle, one large red circle, one small blue triangle, etc. In administering the test only 16 of the objects are used (two are withheld from the set presented to the child). The reason for only using 16 is to force the child, when (s)he selects 9 objects, to have a mix of large and small objects.

The test is administered on an individual basis by a single interviewer working with a single child. The subject is seated at a table on which one of the boards is placed down flat. Then 16 objects are taken out of a pile and scattered

around the perimeter of the board by the experimenter. The subject is told to pick out any 9 objects from the pile and place one object in the middle of each of the 9 boxes on the board which is facing him. The subject is told that while (s)he can pick out any 9 objects (s)he likes, (s)he should try to mix the selections up as much as possible. After the subject has completed the placement of the objects, (s)he is told the following:

"I would like you to imagine that in a day or two another boy or girl about your own age will come into another room and a board just like this one will be placed down in front of him or her just in the same way that this board is facing you. (position the second board on another table facing the same direction as the subject's board). Now this other child won't be able to see your board or any of the objects on it because I am going to remove all of these objects and mix them up again into the same big pile that I gave you. I would like you to try to help this other person to pick out the same 9 objects that you picked out and arrange them in the same places on his/her board so that their board looks just the same as your board. The way you are going to help him/her is like this: tell me everything you think that I should tell them so that they can make their board look like yours. I will write down every word you say and then when this other boy/girl sits down I'll read him/her your instructions and that will help the other child to make the same design on his/her board that you made on yours. Now remember, this child won't be able to see your board. So you must try to

give really good instructions so that you can help him/her to make his/her everything you think he/she needs to know. Do you think you can do that? (If answer indicates confusion, repeat instructions as many times as are necessary). All right, you can begin."

As soon as the subject begins to dictate his or her instructions, the tester starts to write down everything (s)he says. For scoring purposes, it is easier if the instructions for each object are written on separately numbered lines. When the child has stopped dictating, the tester says "Very good. Have you finished, or is there anything else you think the other child will need to know to make his or her board look just like yours?" If answer is "yes," ask the child to continue. If answer is "no" thank the child. At completion of second complete dictation, thank the child (do not re-ask whether he can think of anything else). Before dismissing the subject, make a sketch of the design for comparison with his or her dictation. Then mix up the objects again and put the materials away.

The subject's performance is scored, at some time after the session, from the written verbatim record. The score is based on the number of necessary items of information omitted by the subject in his dictation. Since there are five referents (shape, size, color, column, row) for each of the nine objects, a subject would need to provide 45 pieces of information in order to attain a perfect score of zero. Conversely, in order to attain a completely egocentric score of 45, a subject would need to provide none of the 45 necessary clues. In order to receive credit for a correct clue, it is not necessary that a subject use the

proper geometric term, but only that (s)he use a term that conveys a consistent meaning. Thus "pointed object" is an acceptable substitute for "triangle." In calculating a subject's score, the scorer adds up the number of correct referents (checking off against the sketch for accuracy) which the subject has given for each of the nine objects. The sum total of correct referents given is then subtracted from 45 and the remaining figure constitutes the subject's egocentrism score. If a subject omits to mention an object, he is penalized the maximum 5 egocentric points for that object. In the event that a subject gives additional information after (s)he is asked if (s)he has anything else to add, the scoring is handled in one of two ways, depending on whether the subject has integrated his second response with his first series of responses. In order for a second response to be added onto a response given in the first series of instructions, it is necessary that the subject make clear which object (s)he is talking about when (s)he provides additional information. Thus, it is necessary for the subject to provide all necessary referents for additional credit to be given for the subject's instructions about a given matrix cell. If the subject, in his or her second run-through, does not provide all necessary referents for a cell, then his or her performance on the second dictation is scored separately and (s)he will be credited with whichever of the two dictations provides him or her with the less egocentric total score.

An additional scoring complication arises whenever a subject adopts a shorthand way of communicating which does not

explicitly mention each of the five referents for each object but which may be adequate nonetheless. To give an example, let us say a subject starts off by saying "Take the red small square and put it in the top left box. Then take the big green circle and put it under it." Since, in this case, it was perfectly clear from his or her first dictation what cell (s)he was talking about, the statement to put the next object "under it" is a perfectly adequate performance (assuming the second object is in the middle row); the subject should not be penalized for failing to explicitly mention row and column. Let us say, however, that his or her initial instruction mentioned left column but not top row. Then the statement to put it "under it" would be credited for column but (s)he would receive an egocentric point for failing to adequately refer to row. If (s)he had first mentioned top row but did not give left column, then (s)he should be penalized in his or her second instruction for failing to adequately refer to column. On the other hand, if the subject initially failed to give row or column, then the second statement to put it "under it" would be penalized two points for failing to provide adequate references to either column or row. Thus, a telegraphic communication is given nonegocentric credit only when one is able to reconstruct, without any guesswork, exactly what the implied missing referents are.

RESULTS

The matrix test of referential communication was analyzed for two kinds of reliability. Test-retest reliability was examined by correlating the first and second test performances (separated by a 3 week period) of 60 children, 10 at each of the grade levels. The Pearson product-moment correlation coefficient was quite high ($r=+.86$, df 58, $p<.001$). This test-retest reliability was consistent across all six of the grade levels. Inter-rater reliability was determined by correlating the independent ratings made by two raters of the referential communication performance of 38 subjects. This index of reliability was, likewise, quite high ($r=+.98$, df 36, $p<.001$).

The relationship between age of subject and referential communication performance was examined by means of a one-way Analysis of Variance which examined differences among mean referential communication scores across the six grade levels. The mean scores ranged from 33.1 at the first-grade level to 4.2 at the sixth grade level (See Table 1). There was a highly significant age effect ($F_{5,108} = 19.9$, $p<.001$) showing that referential communication performance does indeed change markedly over this age span. In order to determine whether and at what points in the curve there were significant increases in performance from one grade to the next, a post-hoc comparison of means was carried out. The Neuman-Keuls test (Winer, 1962) found only two such significant

break-points. These jumps occurred between first and second grade ($p < .01$) and between fifth and sixth grade ($p < .02$).

Insert Table 1 about here

The comparison of referential communication scores between the matched samples of normal and emotionally disturbed children showed sizeable differences. The normal group was relatively non-egocentric (M = 7.8, S.D. = 6.7) while the emotionally disturbed group was quite egocentric (M = 22.9, S.D. = 11.8). The differences between these means was highly statistically significant ($t = 6.04$, df 58, $p < .001$).

The other cross-sectional studies of the relationship between referential communication and socioemotional adjustment showed mixed patterns of results. For the peer ratings, the results were as follows: at Institution A, there was a nonsignificant correlation between egocentrism status and summary sociometric scores ($r = -.16$, df 18, $p > .2$). At Institution B, however, there was a highly statistically significant correlation ($r = +.86$, df 18, $p < .001$). For the teacher rating, the results were similar. At Institution A, there was a nonsignificant correlation ($r = +.15$, df 18, $p > .25$), while at Institution B there was a statistically significant relationship ($r = +.54$, df 18, $p < .01$).

In the longitudinal study of the relationship between short-term (3 month) change in referential communication and long-term improvement or regression in adjustment, there was also a mixed pattern of results. For the 6-month followup, using the modified version of the AML checklist, there was a significant positive correlation, at Institution A, between referential communication change and behavioral improvement six months later ($r = +.38$, df 22, $p < .05$). At Institution B, however, there was a non-significant correlation between the two variables ($r = +.2$, df 21, $p > .15$). For the 12-month followup, neither of the two rank-orderings of behavior change at Institution A were significantly related to referential communication change ($r_s = -.04$, df 23 and $r_s = -.1$, df 23). At Institution B, there was a statistically significant positive correlation for one of the two raters ($r_s = +.49$, df 21, $p < .05$), while the change ranking of the second rater was not significantly related to referential communication change ($r_s = +.09$, df 21, $p > .1$).

DISCUSSION

The matrix test of referential communication was shown to be a highly reliable instrument which has clear-cut validity as a correlate of age level and which has been shown to have potential usefulness as an index of socioemotional adjustment. In normal children, of middle class backgrounds, performance on the matrix test of referential communication appears to follow an age trend clearly in keeping with Piaget's postulated stages of cognitive development (Flavell, 1963). Until second grade (ages 7 to 8), children are highly "egocentric" in their communication performance, providing little more than one-fifth of the necessary 45 clues. A dramatic improvement in performance occurred when these children entered the second grade. At this age level, children are providing well over half of the necessary clues. The subjects are now relatively rather than absolutely egocentric. That is, they now appear to show some awareness of the need to take the informational needs and perspective differences of the listener into account, whereas before they appeared not to recognize that this problem even existed. But the second graders still are relatively egocentric in that they do an imperfect and somewhat haphazard job of communicating. They still leave out vital pieces of information and seem to shift from one communication strategy to another, sometimes providing information about one dimension of the objects, sometimes about another, but only occasionally

providing coordinated information about all of the dimensions of all of the objects. There was a gradual shift upwards in the communication performance of children as they got older, but this improvement was so gradual that it was neither statistically nor psychologically significant until children entered the sixth grade (ages 11 to 12). At that point, there was a sizeable leap from a performance in which children still managed to leave out, on average, about one-fourth of the clues to a performance in which they did a virtually error-free job of communicating all of the necessary pieces of information. While sixth grade children will still make an occasional omission, these appear to stem from mere oversight rather than from the absence of a systematic combinatorial solution to the problem.

The fact that the matrix test is sensitive to changes occurring at entry into both of the major Piagetian stages of middle and late childhood is noteworthy in that most of the standard Piagetian assessment tasks, such as conservation of mass, are sensitive to changes either at the lower or upper limits of the concrete operational period. Thus, the test would seem to have potential benefit as an addition to the growing number of Piagetian assessment tasks. A major issue which should be resolved before such a step could be contemplated, would be to establish the exact role of the child's verbal and other cognitive abilities as factors underlying performance on the task. Although the matrix test was deliberately designed in such a way that it places minimal demands on the child's ability to verbally label

the objects in the task, research is needed to establish whether or not this factor accounts for any or a considerable amount of the variance. Also, in order to establish whether referential communication performance is a behavioral dimension separate from or totally dependent upon the child's cognitive level, studies must be undertaken in which performance on the matrix task is correlated with performance on a wide variety of other cognitive and social-cognitive tasks.

The data on the socioemotional correlates of referential communication are equally interesting, although not as conclusive, as the data on age correlates. It was found that moderately emotionally disturbed 11- and 12-year old children are functioning at a level of referential communication roughly equivalent to that obtained by normal children when they are seven or eight. While the lack of demographic and intellectual equivalence among the matched samples raises the possibility that these differences may not be reflective solely of emotional factors, the fact of such wide disparity between the two groups suggests that the matrix test may be tapping into a major dimension of difference between normal and emotionally disturbed children. This possibility is given additional weight by the other findings of study 2. The cross-sectional studies of the relationship between referential communication performance and adjustment, as measured by teacher ratings and peer ratings, provided some evidence that children who are egocentric relative to their institutionalized peers will also be perceived as exhibiting more negative behaviors. The longitudinal data also provided some evidence to

suggest that when highly egocentric emotionally disturbed children improve in their communication performance, they will be more likely to be perceived as having made positive changes in their level of adjustment. These conclusions, although only partially confirmed by the study results, provide encouraging support for additional in-depth investigations. A central focus of such research should be to determine whether referential communication is a corollary of emotional disturbance in children or whether the inability to communicate effectively and to take the perspectives of others into account, is a significant underlying factor which causes these children to behave in ways which are likely to be perceived and labelled as "disturbed" by adults and peers alike.

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FOOTNOTES

[1]This paper was presented at the 5th Annual Symposium of the Jean Piaget Society, Philadelphia, June 13-14, 1975.

[2]Stephen Greenspan's address is now: Neuropsychiatric Institute, University of California, Los Angeles, California 90024. Carl Barenboim's address is now: Psychology Department, University of Pittsburgh, Pittsburgh, Pennsylvania. The research described in this paper was conducted at the University of Rochester. The authors are indebted to their mentor, Michael J. Chandler, for his many helpful contributions to this research.

[3]The authors are indebted to Professor Michael Davidson, of the University of Rochester, for suggesting this alternative explanation. The terms "instrumental" and "depictive" are his.

[4]Because of the somewhat cumbersome size of the boards, the authors and other investigators have been experimenting with boards and objects which are considerably scaled down in size from the ones used in this study. While systematic comparative data is not yet available, there appears to be no reason why smaller sets of materials cannot be used with comparable results. It is important, however, that the relative sizes of the "large" and "small" geometric objects be maintained at the same 4 to 2.5 ratio as was used in this study.

Table 1: Means and Standard Deviations for Normal Children's Performance on the Matrix Test of Referential Communication, by Grade.

	Grade level					
	1	2	3	4	5	6
Mean	33.1	19.3	17.7	16.1	11.9	4.2
S.D.	9.7	12.5	10.4	7.8	8.2	5.3